Position Description

1. General Information

Name of the position	**Developing new antimicrobial solutions to overcome antibiotic resistance**
Foreseen enrolment date	1 October 2024
Position is funded by	• COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • Institut de Chimie et des Matériaux Paris-Est (ICMPE) • The University of South Wales (UNSW)
Research Host	Institut de Chimie et des Matériaux Paris-Est (ICMPE)
PhD awarding institutions	Université Paris-Est Créteil (UPEC) & The University of New South Wales (UNSW)
Locations	Primary: Thiais, France Secondary: Sydney, Australia
Supervisors	Prof. Davy-Louis Versace (ICMPE/UPEC) Prof. Cyrille Boyer (UNSW)
Group of discipline	Chemistry, Polymer Science, Nanomedicine, Photochemistry, Microbiology

2. Research topics (only one of these projects will be funded)

Project 1: *Understanding the effect of the antimicrobial polymers and resulting materials on their antimicrobial activities to overcome antibiotic resistance*
Antibiotic resistance is a growing threat for human health. Indeed, by 2050 an estimated 50 million people could be affected annually which will have a significant economic impact. In this project, we propose to design and investigate bioactive polymers capable of selectively killing bacteria. By synthesizing well-defined polymers, where each monomer unit is precisely placed in the polymer chain, we will correlate anti-microbial activities for a range of bacteria, with the polymer architectures and structures. To achieve this goal, we will use the most recent polymerization techniques, including photoinduced electron/energy transfer – reversible addition fragmentation chain transfer polymerization, to prepare these antimicrobial polymers. This project combines polymer synthesis with microbiology. The candidate will gain expertise in polymer synthesis, polymer characterisation using a range of techniques, including size exclusion chromatography, NMR, dynamic light scattering, UV-visible spectroscopy, as well as microbiology tests, such as MIC, CFU, fluorescence microscopy, etc.

This project has received funding from the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement № 101081465

Supervisors:

Professor Davy-Louis Versace (ICMPE/UPEC); Prof. Cyrille Boyer (UNSW)
Non-academic supervisor: Professor Jean-Winoc Decousser (APHP)

Research Fields: (Photo)Chemistry, Polymer Science, Microbiology

Project 2: *Overcoming antimicrobial resistance using photodynamic therapy with antimicrobial polymers*

Antibiotic resistance is a growing threat for human health. Indeed, by 2050 an estimated 50 million people could be affected annually which will have a significant economic impact. In this project, we propose to design and investigate bioactive polymers capable of selectively killing bacteria. In this project, we propose to combine the activity of antimicrobial polymers with photodynamic therapy to eradicate bacteria. To achieve this goal, we will use the most recent polymerization techniques, including photoinduced electron/energy transfer – reversible addition fragmentation chain transfer polymerization, to prepare antimicrobial polymers and incorporate porphyrin molecules which can be excited by visible or Near Infra-red light. Under light irradiation, the excited porphyrin molecules will convert oxygen into reactive oxygen species. This project will investigate the synergy of the antimicrobial polymer with reactive oxygen species. This project combines polymer synthesis, photochemistry with microbiology. The candidate will gain valuable expertise in the preparation of porphyrin molecules which will be incorporated into synthetic polymer chains. Therefore, the candidate will learn a broad range of techniques used for the characterisation of porphyrins, the synthesis of synthetic polymers using advanced macromolecular synthesis technique and microbiology tests to evaluate the performance of these new macromolecular compounds. Nuclear Resonance Magnetic, size exclusion chromatography, dynamic light scattering, UV-visible spectroscopy, as well as microbiology tests, such as MIC, CFU, fluorescence microscopy will be routinely employed by the candidate.

Supervisors:

Professor Davy-Louis Versace (ICMPE/UPEC); Prof. Cyrille Boyer (UNSW)
Non-academic supervisor: Professor Jean-Winoc Decousser (APHP)

Research Fields: (Photo)Chemistry, Polymer Science, Microbiology

Project 3: *Design photoactivated polymeric nanoparticles as new antimicrobial agents*

Antibiotic resistance is a growing threat for human health. Indeed, by 2050 an estimated 50 million people could be affected annually which will have a significant economic impact. In this project, we propose to design and investigate polymeric nanoparticles capable of selectively killing bacteria. More specifically, we propose to design polymeric nanoparticles for the local delivery of antibiotics with photodynamic therapy to selectively eradicate bacteria. To achieve this goal, we will use the most recent polymerization techniques, including photoinduced electron/energy transfer – reversible addition fragmentation chain transfer polymerization, to prepare functional nanoparticles which will contain porphyrin molecules and antibiotic agents. Under light irradiation, porphyrin molecules will be excited by visible or Near Infra-red light which will convert oxygen into reactive oxygen species (singlet oxygen or superoxide). This project will investigate the synergy of the reactive oxygen species with antibiotic agents. This project combines polymer synthesis, photochemistry with microbiology. The candidate will gain valuable expertise in the preparation of porphyrin molecules which will be incorporated into polymeric nanoparticles. The size and morphology of these nano-objects will be investigated as well as their loading efficiency. Therefore, the candidate will learn a broad range of techniques used for the characterisation of porphyrins, the synthesis of polymeric nanoparticles using advanced macromolecular synthesis technique and microbiology tests to evaluate the performance of these new macromolecular compounds. Nuclear Resonance Magnetic, size exclusion chromatography, dynamic light scattering, UV-visible spectroscopy, as well as microbiology tests, such as MIC, CFU, fluorescence microscopy will be routinely employed by the candidate. This project combines the main expertise of the two research groups, nanomedicine and preparation of porphyrin.

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Supervisors: Professor Davy-Louis Versace (ICMPE/UPEC); Prof. Cyrille Boyer (UNSW) Non-academic supervisor: Professor Jean-Winoc Decousser (APHP)
Research Fields: Chemistry, Materials science, Nanomedicine, Polymer Science, Microbiology

3. Employment Benefits and Conditions

The Institut de Chimie et des Matériaux Paris-Est (ICMPE) - Université de Paris-Est Créteil (UPEC) / Centre National de la Recherche Scientifique (CNRS) offers a 36-months full-time work contract (with the option to extend up to a maximum of 42 months). A probation period of 2 month will apply. The legal working time is 38h and 40 min per week.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a gross annual salary of 28,800 EUR. Of this amount, the estimated net salary to be perceived by the Researcher is 1,850 EUR per month. However, the definite amount to be received by the Researcher is subject to national tax legislation.

Benefits include

- Becoming a Marie Skłodowska-Curie fellow and be invited to join the Marie Curie Alumni Association.
- Access to all the necessary facilities and laboratories at ICMPE – UPEC/CNRS and UNSW.
- Tuition fees exemption at both PhD awarding institutions.
- Yearly travel allowance to cover flights and accommodation for participating in AUFRANDE events.
- 10,000 EUR allowance to cover flights and living expenses for 12 months in Australia.
- 45 days paid per year holiday leave.
- Affiliation to the French social security system and its legislation on accidents at work.

4. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to AUFRANDE's conditions.

Applicants must hold a Master degree with a substantial research component and demonstrated capacity for timely completion of a high-quality research thesis.

Applicants must demonstrate an English language proficiency equivalent to an overall IELTS score above 6.5 and no band below 6. Note that the test needs to be completed no more than two years before enrolment. For more information about the tests accepted and scores required, visit:
https://www.unsw.edu.au/study/how-to-apply/english-language-requirements

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More information on UPEC's requirements

Approval of the CNRS defence security officer may be required before the starting of employment. In case of denial, the employment will not be carried out.

Visit the website: https://www.paris-est-sup.fr/ecoles-doctorales/ecole-doctorale-sciences-ingenierie-et-environnement-sie/accueil/

More information on UNSW' requirements

Applicants will be required to submit an application on UNSW website in parallel.

Visit the website: https://research.unsw.edu.au/higher-degree-research-programs

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